Skill Enhancement Courses (SEC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501PT19	MATLAB For Petroleum Engineers Lab	IC			2	2	50	50	100	-
2501PT51	Well Control and Pressure Control Lab	IC			1	1	100	-	100	-
2501PT20	Petroleum Equipment Design and Simulation Lab	IC			2	2	50	50	100	SPO
2501PT18	Drilling Simulation Lab	AC			2	2	50	50	100	-
2501PT21	Unit Operations Using SCI Lab	AC			2	2	50	50	100	FMPE & HTPO
Total					**9**	**9**				

MATLAB for Petrolem Engineers Lab

	L	T	P	C
Course Code: 2501PT19	**0**	**0**	**2**	**2**

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Develop a program to create geological model using simple matlab code.
CO2: Make use of different homogeneous models for geological layers.
CO3: Apply the concepts of flow models in porous media.
CO4: Build grids of structured, unstructured and complex grids.
CO5: Develop GUI for the Grids Generated using the MRST

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2	-	-	3	-	-	-	1	-	-
CO2	2	2	-	-	3	-	-	-	1	-	-
CO3	2	2	-	-	3	-	-	-	1	-	-
CO4	2	2	-	-	3	-	-	-	1	-	-
CO5	2	2	-	-	3	-	-	-	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	-	3
CO3	3	-
CO4	-	-
CO5	-	-

List of Practices

1. Data representation, error analysis, introduction to MATLAB; Applied MATLAB programming
2. Structured programming and looping
3. Numerical solution of algebraic and transcendental equations.
4. Create a geological model is a grid describing the geometry of the reservoir rock, here chosen as a regular 1 × 1 × 30 Cartesian grid.
5. Curve fitting: Straight line fit, polynomial curve fit and exponential curve Fit.
6. Numerical integration: Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule,
7. Solution of simultaneous algebraic equations: Gauss elimination method.

8. Numerical solution of ordinary differential equation: Taylor's method, Euler's method, Runge- Kutta method, modified Euler's method; Predictor corrector method: Adam's method and Milne's method.
9. consider a reservoir consisting of a homogeneous 500 × 500 × 25 m3 sand box with an isotropic permeability of 100 mD, represented on a regular 20 × 20 × 5 Cartesian grid.
10. Optimization algorithms and introduction to Simulink.

Additional Practices:

1. Consider a homogeneous reservoir in the form of a 2D rectangle [0,4] × [0,1]. Flow is driven from the north to the south side of the reservoir by a fluid source with unit rate located at (2,0.975)
2. Construct a Radial symmetric grids graded towards the origin are commonly used to increase resolution near wells.
3. Construct an areal Voronoi grid from a set of generating points obtained by perturbing the vertices of a regular Cartesian grid and then use the function makeLayeredGrid to extrude this Voronoi grid to 3D along vertical pillars in the z-direction.

Textbooks:

1 Knut-Andreas Lie ,An introduction to reservoir simulation using matbabgnu and Octave, User Guide for the MATLAB Reservoir Simulation Toolbox (MRST),Cambridge press, 2019 eISBN: 9781108492430

2 Chapra, S., "Applied Numerical Methods with MATLAB for Engineers and Scientists", Edition: 4, McGraw-Hill Education (2017). eISBN: 9780077144883

Reference Books:

1 Pratap, R. "Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers'', Ox- ford University Press, (2010). eISBN: 9780199731244

2 Ahuja, P. "Introduction to Numerical Methods in Chemical Engineering", PHI Learning Pvt., Edi- tion: 2 (2019). eISBN: 9789389347173

Web Links:

1 https://www.mathworks.com/academia/books/an-introduction-to-reservoir-simulation-using-matlab-gnu-octave-lie.html

2 https://www.sintef.no/contentassets/8af8db2e42614f7fb94fb0c68f5bc256/mrst-book-2016.pdf

3 https://www.cambridge.org/core/books/an-introduction-to-reservoir-simulation-using-matlabgnu-octave/modeling-reservoir-rocks/D54C1FD08E64FDD810436E0651E40650

Well Control & Pressure Control Lab

	L	T	P	C
Course Code: 2501PT51	0	0	1	1

Course Outcomes:
At the end of the Course, Student will be able to:

CO 1: Make use of excel to solve the area and volume calculations.
CO 2: Calculate the examples related to volume, capacities and displacements
CO 3: Explain the well control risk and borehole geometry
CO 4: Study and solve the gas laws and its characteristics
CO 5: Study the concept of circulating system.

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	2	2	-	2	-	-	-	2	-	-
CO2	-	2	2	-	2	-	-	-	2	-	-
CO3	-	3	3	-	3	-	-	-	2	-	-
CO4	-	3	3	-	3	-	-	-	2	-	-
CO5	-	3	3	-	3	-	-	-	2	-	-

Mapping of course outcomes with program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

List of Experiments:

1. **Introductory Concepts:** Areas and Volumes
   - I. Perimeter and area
   - II. Units of area
   - III. Angles
   - IV. Areas of regular shapes
   - V. Conservation of area
2. **Volumes, Capacities and Displacements**
   - I. Calculating mud pit volumes and capacity
   - II. Calculating the volume of a cylinder
   - III. Calculating the capacity of a cylinder in bbl/ft
   - IV. Calculating annular volumes
   - V. Calculating annular capacities
   - VI. Calculating drill pipe, casing and tubing capacities
   - VII. Calculating metal displacement
   - VIII. Calculating closed end displacements

3. **Well Control Risks When Tripping**
   I. Tripping 'dry' and tripping 'wet'
   II. Tripping into the well
   III. Tripping out of the well
   IV. Trip tanks
   V. Trip sheets

4. **Borehole Geometry**
   I. Drill string capacity and annular volumes
   II. Surface and subsea well geometry
   III. Calculating drill string capacity and annular volumes for a surface well
   IV. Calculating drill string capacity and annular volumes for a subsea well

5. **Gas and its characteristics**
   I. Gas and gas characteristics
   II. Gas mass
   III. Gas density
   IV. Pressure gradient

6. **Gas Laws**
   I. How gas changes with pressure
   II. Gas density changes with pressure
   III. High pressure gases
   IV. Ideal gas law

7. **Accumulator bottles**
   I. Accumulator capacity calculations
   II. Accumulator pre-charge
   III. Accumulator minimum operating pressure
   IV. Accumulator maximum operating pressure
   V. Useable hydraulic fluid volume

8. **The Circulating System**
   I. Understanding pump pressure
   II. Combining several pipe sections into a system
   III. The drilling circulating system
   IV. Mud pump pressure in a circulating system
   V. Changes in pump rate
   VI. Changes in drilling fluid density

9. **Effect of Circulation on Bottomhole Pressure**
   I. The effect of circulating pressures on bottomhole pressure (BHP)
   II. The effect of annular pressure loss on BHP
   III. Equivalent circulating density (ECD)

10. **Pump outputs, Strokes and Circulating time**
   I. Pump output and pump strokes
   II. Calculating the required number of strokes
   III. Calculating the time required to pump a volume of fluid
   IV. Using both formulas with given well data

Reference Books:

1. Drilling Engineering" by J.J. Azar and G. Robello Samuel ISBN: 978-0750678613
2. Applied Drilling Engineering" by Adam T. Bourgoyne Jr., et al. ISBN: 978-0884152585

Web Links:

I. https://iwcf.org/well-control-pressure-calculations/#/

Petroleum Equipment Design & Simulation Lab

	L	T	P	C
Course Code: 2501PT20	0	0	2	2

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Design and simulation of the two-phase, three phase separators and compressors
CO2: Design and simulation of absorber-stripper unit for removal of CO2 and H2S from natural gas
CO3: Size /rate the pipeline & pumping systems for liquid pumping & simulate water hammer conditions
CO4: Design and simulation of flash vaporization units
CO5: Generating sized equipment data sheets as per the industry standards with required information fordetailed design / manufacture

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	-	-	-	-	2	-	-	-	2	2	1
CO2	-	-	-	-	2	-	-	-	2	2	1
CO3	-	-	-	-	2	-	-	-	2	2	1
CO4	-	-	-	-	2	-	-	-	2	2	1
CO5	-	-	-	-	2	-	-	-	2	2	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

List of Practices:

1. Study Oil- Water separator
2. Study Gas- Oil-Water separator
3. Study Lean / rich amine heat exchanger
4. Study Air-cooled heat exchanger.
5. Study CO2 and H2S absorber unit using, MEA/DEA amine solution.
6. Study Stripping unit
7. Study Single stage flash vaporization unit

8. Study three stage flash vaporization unit.
9. Study Liquid pumping system & simulation of water-hammer phenomena
10. Study Gas Compressor unit

List of Additional Practices:
1. Study Expander
2. Study Conversion Reaction
3. Study Equilibrium Reaction

Reference Books:

1. Process Modeling, Simulation and Control for Chemical Engineering, Luyben, McGraw Hill Education;2 editions, 2013. eISBN: 9780070391598
2. Optimization of Chemical Processes, Thomas F. Edgar, David M. Himmelblau, Thomas E. Casson, 2ndEdition, 2001. eISBN: 9780071189774
3. Elements of Chemical Reaction Engineering, Fogler H.S, Prentice Hall India Learning Private Limited;4 edition, 2008. eISBN: 9780131278394

Web Links:
1. https://petrowiki.org/Oil_and_gas_separators
2. http://www.thermopedia.com/content/551/
3. https://en.wikipedia.org/wiki/Amine_gas_treating
4. www.chemprosys.com/products/evoporators/multi-stage-flash/
5. https://worldwidescience.org/topicpages/w/water+hammer+phenomena.html

Drilling Simulation Lab

	L	T	P	C
Course Code: 2501PT18	**0**	**0**	**2**	**2**

Course Outcomes:
At the end of the Course, Student will be able to:

CO1:	Evaluate the suitability of drilling Simulator by performing different laboratory tests
CO2:	Analyse the effect of adding different drilling parameters with simulatio
CO3:	Analyse the effect of adding different kick parameters with simulatio
CO4:	Estimate the kick bynusing methods.
CO5:	Function effectively as an individual, and as a member or leader while performing lab experiments.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	-	-	-	-	-	-	2	-	-	-
CO2	2	-	-	-	-	-	-	2	-	-	-
CO3	2	-	-	-	-	-	-	2	-	-	-
CO4	2	-	-	-	-	-	-	2	-	-	-
CO5	2	-	-	-	-	-	-	3	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	2	-
CO3	-	2
CO4	2	-
CO5	-	-

List of Practices:

1. Drilling a vertical well up to a certain depth using the various drilling systems such as the hoisting system and the rotary system.
2. Calculation and monitoring of all the drilling parameters such as the drilling rate (rate of penetration, ROP), rotary speed, drill pipe pressure, casing pressure, mud weight etc.
3. Setting up of a situation where a kick is induced into a well and fixing it using the driller’s method (two circulation method). Preparation of a kill sheet.
4. Resolving a kick using the wait of weight method (Engineer’s method, one circulation method). Preparation of a kill sheet.
5. Resolving a kick using the volumetric method. Preparation of a kill sheet.
6. Resolving a kick using the concurrent method. Preparation of a kill sheet.
7. Resolving the drilling problem when a choke is plugged.
8. Resolving a drilling problem when a choke is washout out.

9. Resolving a drilling problem when a bit nozzle is plugged.
10. Evaluate the effect of differential sticking on drilling.

Additional Practices:
1. Resolving a drilling problem when the well is packed-off.
2. Evaluate the effect of surge and swabbing on drilling.

Text Books:

1	Lab Manual For Drilling Simulator

Reference Books:

1	Well Control Problems Solutions : Neal A J.dams 1983 eISBN: 9780878141241

Unit Operations Using SCI Lab

Course Code: 2501PT21	L	T	P	C
	0	0	2	2

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Develop simulation to optimize column performance with Distillation Column.
CO2: Make use of various methods to determine heat transfer coefficients.
CO3: Apply hydrodynamics and reaction kinetics within fluidized bed systems
CO4: Develop empirical models to predict pump performance under varying conditions
CO5: Simulate the evaporation of a liquid in a single-effect or multi-effect evaporator

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2	-	-	3	-	-	-	1	-	-
CO2	2	2	-	-	3	-	-	-	1	-	-
CO3	2	2	-	-	3	-	-	-	1	-	-
CO4	2	2	-	-	3	-	-	-	1	-	-
CO5	2	2	-	-	3	-	-	-	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	-	3
CO3	3	-
CO4	-	3
CO5	2	-

List of Practices:

1. Distillation Column Simulation:
   Simulate the operation of a distillation column to separate a binary mixture using the McCabe-Thiele method or other equilibrium-based approaches.
2. Heat Exchanger Performance Analysis:
   Analyze the heat transfer characteristics of a shell-and-tube heat exchanger under various operating conditions.
3. Fluidized Bed Reactor Simulation:
   Simulate the behavior of a fluidized bed reactor for gas-solid reactions and investigate the effects of different parameters on reactor performance.
4. Pump Performance Curve Estimation:
   Estimate the performance curve of a centrifugal pump by analyzing its head-flow characteristics using experimental data.
5. Mixer-Settler Design and Optimization:
   Design and optimize a mixer-settler unit for liquid-liquid extraction processes, considering factors such as residence time and phase distribution.

6. Fluid Flow in Pipes:
   Analyze the pressure drop and flow characteristics of fluids in pipes of different diameters and lengths using SCILAB's fluid dynamics simulation capabilities.
7. Solid-Liquid Filtration Experiment:
   Simulate the filtration process in a filter press or filter medium to determine the filtration rate, cake formation, and pressure drop.
8. Crystallization Process Modelling:
   Model the crystallization process in a batch or continuous crystallizer to predict crystal size distribution and yield under varying conditions.
9. Evaporation Process Simulation:
   Simulate the evaporation of a liquid in a single-effect or multi-effect evaporator to determine heat transfer coefficients and evaporation rates.
10. Absorption Tower Design:
    Design and analyze the performance of a packed or tray absorption tower for gas-liquid mass transfer processes, such as CO2 removal from flue gases.

Additional Practices:

1. Centrifugation Experiment:
   Analyze the separation efficiency of a centrifuge for solid-liquid or liquid-liquid separation processes and optimize operating parameters.
2. Fluid Mixing Analysis:
   Investigate the mixing efficiency and time required to achieve homogeneity in a stirred tank reactor or mixing vessel under different agitation speeds.
3. Gas-Liquid Mass Transfer Experiment:
   Study the mass transfer characteristics of a gas-liquid contactor, such as a bubble column or stirred tank, for absorption or stripping processes.

Text Books:

1 Scilab Code for Unit Operations of Chemical Engineering, Warren L. McCabe, Julian C. Smith, Peter Harriott, McGraw Hill, 2010. eISBN: 0-07-112738-0

2 Introduction to Scilab: For Engineers and Scientists, Sandeep Nagar, APress; 1st ed. Edition, 2017. eISBN: 978-1484231959

Reference Books:

1 Introduction to Scilab, Rachna Verma, Arvind Verma, independently published, 2018. eISBN: 9789353008390

2 Scilab: from Theory to Practice - I. Fundamentals, Philippe Roux, Éditions D-BookeR, 2016 eISBN: 9782822702928

Web Links:

1 https://www.opensourceforu.com/2015/05/using-scilab-with-the-mccabe-thiele-method/

2 https://www.colan.org/process-modeling-component/scilab-unit-operation/

3 https://kpriet.ac.in/stories/898/dynamic-simulation-of-a-distillation-column-in-dwsim

4 http://surl.li/tvqos

5 http://surl.li/tvqok